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Zero Retries is an independent newsletter about technological innovation in Amateur Radio. Zero Retries promotes Amateur Radio as (literally) a license to experiment with radio technology.

About Zero Retries

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In this issue:

- **Request To Send**
  - **Omnibus 0090 - Whew!**
  - **Tesla Investor Day 2023**
  - **Blog About US Bases at the South Pole**
- **Black Box Radio Using an App as a Front Panel**
- **Future Tesla Vehicles Will Use 48 Volt Internal Bus**
- **ZR > BEACON**
- **Zero Retries 0091 Poll**
- **Feedback Loop**
- **Join the *Fun* on Amateur Radio**
- **Closing The Channel**

Request To Send

Omnibus 0090 - Whew!

It's always a relief to put another Omnibus of Zero Retries Interesting Information in the rear view mirror, at least for a few months. One thing that makes it easier to maintain is that upon finishing one, start the next one immediately, which I've now done. And then, when I discover "Oh, *this* is interesting" items, make it a habit to add them upon discovery. In writing this issue of ZR, I've already added two items to the next Omnibus.

Tesla Investor Day 2023

I watched Tesla Investor Day 2023. It was like watching the future unfold, not dissimilar to watching Steve Jobs unveil the iPhone or (and I'm dating myself) the "You Will" ad campaign from the mid-1990s that in retrospect looks prescient (except for AT&T's involvement). Tesla focused on *how* they will continue to advance the increased production rate of battery electric vehicles, continually improving their efficiency at producing vehicles, and how the cumulative effect of those changes will ultimately lower the cost of battery electric vehicles to parity… and below… the cost of vehicles with internal combustion engines. The entire presentation was *technical* - they explained what they wanted to do, and explained in technical detail how they intended to change their products and processes to achieve their goals. I found it impressive that they didn't dumb down the subjects they discussed. Note that none of this was "The Cult of Musk" stuff (other than the obligatory plugs for "full self driving" - eventually). I mention this video because one key technical decision Tesla has made for their future vehicles will ripple through the automotive industry and begin to affect Amateur Radio - see the story later in this issue.

Blog About US Bases at the South Pole

Ever imagined what it would be life to live and work at the South Pole US bases? A new resident is blogging, from a geek's perspective, about what it's really like - https://brr.fyi. (Nothing about Amateur Radio… but still amply fascinating.)

de Steve N8GNJ

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Black Box Radio Using an App as a Front Panel

By Steve Stroh N8GNJ

In Zero Retries 0080, in Followup on A Vision for Zero Retries Interesting Amateur Radio in 2029, I said:

Black Box Radios

> *Another AmNet product, the BB-100 (BB - Black Box) was a simple "black box" whose user interface was a smartphone / tablet app or a web app running within a computer's web browser.*

This didn't seem like much of a projection, but rather an observation that Amateur Radio radio units, even those with minimal, remote control / display units, are increasingly problematic in modern vehicles. That, while simultaneously, vehicles are evolving to make it smartphone use convenient - magnetic mounting / inductive charging points on the dash, wireless audio integration, etc. Clip the smartphone into the magnetic mounting point, insert your smartphone earbuds, and bring up the "BB-100" app and you're on the air. Some smart vendor is going to get this right, and soon. Such a product would blaze right past all of the existing Amateur Radio vendors - Blackberry versus iPhone redux.

Also as background for this story, in Zero Retries 0065, I highlighted the Anytone BT-01 - New "Radio without the RF" Device. It is an auxiliary Display / Control / Microphone / Speaker device that can connect to recent Anytone radios.

> For me, the BT-01 nicely solves a problem in N8GNJ Labs that portable radios don't work well inside the Labs because it has steel sides, aluminum clad garage doors, and a metal roof - a good Faraday Cage. So I have an external antenna and "base station" radios, but those radios are in a specific spot in the Labs that I'm usually not near unless I'm doing a radio activity. Thus, I miss out on a lot of opportunities for casual chatting on the local repeaters.

It turns out that an Amateur Radio unit, with no integral (or optional) front panel *exists*! Meet the VGC / VERO VR-N7500.

Image courtesy of R and L Electronics

As I imagined, the "front panel" is an app on a smartphone or tablet and the connection is Bluetooth. Of course, any modern vehicle supports Bluetooth audio for hands-free operation and the VR-N7500 can also pair its audio to the vehicle Bluetooth audio system.

Apparently the VR-N7500 has been available since early 2020… but I was unaware of it. Other than the Bluetooth connectivity and panel apps, the VR-N7500 appears to be a small, but conventional dual band (144 -148 MHz, 50 watts and 440 - 450 MHz, 40 watts) FM transceiver. The Bluetooth functionality not only extends to the "front panel app" paradigm, but some accessories:

- **BMH75** - Bluetooth microphone / speaker
- **BMH78GN** (Green) / **BMH78OR** (Orange) - a Bluetooth remote speaker / microphone / display.
- **Bluetooth PTT** - Bluetooth Push-To-Talk (PTT) button

The BMH75 looks like a typical Push-To-Talk microphone without a cord.

The BMH78 is similar in function to the Anytone BT-01, but it resembles a portable radio more than the BT-01.

Another interesting feature of the VR-N7500 is that it has incorporates Automatic Packet Reporting System (APRS)… but the APRS functionality is implemented *entirely within the app, not the radio* (there's apparently no modem, satellite position receiver, or Terminal Node Controller [TNC] hardware in the radio). Apparently the positioning and packet radio audio is handled entirely within the app, including maps.

There is no link to a manual on the manufacturer's product page. I did find a link to a manual written by Min Standen G0JMS last updated 2020-01-27 - VR N7500 Manual V3.1 (PDF) . The manufacturer's manual (PDF) pales in comparison; a *brochure* provides more info than the "manual". Suffice it to say that you'll do some "experimenting" in learning to use the VR-N7500.

Josh Nash KI6NAZ does a good job reviewing the VR-N7500 in the 2022-09-27 episode VGC VR-N7500: APRS! Android, iOS, Bluetooth, Dual Band 2m/7cm Ham Radio Review on his YouTube channel **Ham Radio Crash Course.** KI6NAZ does a better job of showing off the app than I can do here in text, so I'll mostly defer to his video and offer some commentary.

- KI6NAZ demonstrates the Android "HT" app to control the VR-N7500. Initially I couldn't find an equivalent IOS app, but then I read the manufacturer's product page carefully, which said:
  IOS APP is in developing, allows to set the frequency and some simple operations on it, other features will be available soon.

  Please visit App Store to download the app which named 'BS HT'.'
  Sure enough, there is an app called "BS HT" for the VR-N7500.

- KI6NAZ mentions in passing that the BMH78 can also be paired with a phone. Perhaps that can provide "real" Push-To-Talk functionality with various "walkie talkie" apps.

- It's not apparent from the product photo, but as KI6NAZ points out, there's no speaker in the radio - the wired microphone is actually a microphone / speaker.

- KI6NAZ claimed that there's a GPS receiver in the radio, but I haven't seen any confirmation of that on the manufacturer's product page or dealers product page.

- As KI6NAZ was running through the settings on the Android app, there was a toggle control for *Pre/De-emphasis* (5:42). Thus, potentially, despite not having a flat audio connector, the VR-N7500 may be able to run fast data modes such as VARA FM which depends on "flat audio" (no pre-emphasis or de-emphasis *if you can couple the audio from a Windows computer via Bluetooth* into the VR-N7500.

- KI6NAZ demonstrated the use of the APRS portion of the app. As soon as the app "hears packets" (such as tuning to the US National APRS frequency - 144.39 MHz), it displays the decoded messages. Note this is built-in functionality to the app, *not a second app*. This is powerful. You can also send an APRS message, but the process to do so (in t*his* version of the app from five months ago) is clunky and unintuitive.

- There's no external Bluetooth antenna (or connection for external) on the unit, so the Bluetooth module is radiating through the metal case (or the plastic (?) faceplate). Thus the range between a Bluetooth accessory - tablet, phone, BMH75, BMH78, etc. isn't great… but likely works fine in a vehicle.

- Multiple Bluetooth devices can be paired simultaneously to the VR-N7500.

Craig Lamparter KM6LYW did a more recent (2023-01-13) review of the VR-N7500 in Install-Anywhere Bluetooth Mobile Radio with APRS on his YouTube channel **KM6LYW Radio**. He had some observations unique from KI6NAZ:

- As often happens with Chinese radio manufacturers, this same (?) or cloned design (?) radio is also available as the Retevis RT99. Retevis does a *far* better (marketing) job with their RT99 product page than VERO / VGC.

- Very interestingly… in the RT99 Support tab of the page, there appears to be a Windows 11 driver!

- And, in Support, Manuals there is a download link for **RT99-Multi-language-Manual**! But it's another disappointment, only slightly better than the NR-N7500 manual. But, kudos to Retevis for at least having it available on the product page.

- In his video KM6LYW displays what appears to be an updated manual for the VR-N7500 titled **VR N7500 Operational Manual V6 Nov 2022 — Okular**. Eventually KM6LYW mentions that there is a Google Group for this radio - https://groups.google.com/g/veron7500, and that the "V6" manual he shows is located the "Documents" section of this group. You have to request access to view the manual, but my request, in mid-afternoon, was granted in minutes. The newer manual is worth the minor effort of requesting access to the Documents - there is *extensive* documentation there. Kudos to author Min Standen G0JMS for his extensive set of documentation for the VR-N7500.

- KM6LYW provides some vehicle installation tips. Basically, if you don't want to use the wired microphone, you can embed the NR-N7500 anywhere in the vehicle, completely hidden, only needing an antenna connection and power connection. (If I "buried" the NR-N7500 in the vehicle, I would only run it at low power and insure there was some reasonable ventilation. I would also install a unit such as the APO3 that would independently automatically remove power after a few minutes .)

- KM6LYW states that the Android app will not work with Android Auto (he tried). To manage the NR-N7500 in a vehicle, you'll have to use a phone or tablet.

The Challenge, should anyone decide to accept it…
One of the most interesting aspects to me about the VR-N7500 / RT99 is that the hardware and the app communicate only via Bluetooth which is an open, documented, accessible protocol that can be reverse engineered with the use of a Bluetooth Protocol Analyzer. Thus, with some effort in

working through the various commands entered on the app, and the response of the radio, this radio could be used with an independently developed app.

This is kind of unique. Radios that are decoupled from their control panels are nothing new - we've had those for decades now. But previously, the interface between the radio and control panel was proprietary and usually physical / electrical. It is damn hard to reverse engineer the protocol and then build an electrical interface to substitute for the the intended control panel.

There are some few radios that provide co-equal access to all radio functions in a web browser (my perception of how FlexRadio units work - the physical front panel is optional) or secondary access to all radio functions in a web browser (my perception of how Icom units work - the app mirrors the control panel). These virtual control panels are coupled to the radio via Ethernet / Internet / TCP/IP.

Thus this increasing, and accessible decoupling between radio and control panel brings up an interesting opportunity…

All of the functionality of the VR-N7500 could be done as well, and undoubtedly *better*, by a Software Defined Transceiver (coupled to an appropriate power amplifier, of course, for reasonable power output) *and a separate app*.

Once the "Independently Developed App (IDA)" is developed and proven for the VR-N7500, it could be applied for use with a Software Defined Transceiver. There's ample prior art for most Software Defined Transceivers, especially with GNU Radio code, and the adaptation needed would essentially be to develop an Application Programming Interface layer so that the App could communicate with GNU Radio for the particular Software Defined Transceiver.

In my opinion, there are about to be ample opportunities to create entirely new classes of applications and capabilities by connecting an application with a Software Defined Transceiver. I explored this a bit in Request To Send in Zero Retries 0080. VarAC is one of the best examples of this trend - a good interface with new capabilities running on an existing platform. "Under the hood", the job of VarAC is largely "guiding" the VARA FM or VARA HF application, which runs on Windows, but the principle of decoupled user interface application and "platform" is the mostly the same.

We're surrounded by amazing technology and Insurmountable Opportunities with this kind of ongoing Technological Innovation in Amateur Radio.

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Future Tesla Vehicles Will Use 48 Volt Internal Bus

By Steve Stroh N8GNJ

(See Request to Send in this issue for additional context.) The choice of 12 volts DC as the power input standard for most Amateur Radio hardware was a result of 12V being the available power supply in automobiles. Tesla's recent decision to use 48 volts DC for the internal power bus of its future vehicles will eventually ripple through the entire automotive industry because of the lower cost and gains in efficiency. Because Tesla is vertically integrated, it can drive this change into widespread acceptance in the automotive industry. Thus, (in my opinion), Tesla's choice of 48V will eventually affect Amateur Radio.

At its Investor Day 2023, Tesla discussed a myriad of initiatives for its future processes, facilities, and vehicle models. One key point was Tesla's decision to use 48 volts DC to power the internal power bus1 (motors, solenoids, electronics, etc.). The reason for this change is simple - there's a *lot* of wiring, and *many* electrical systems, in a Tesla vehicle. Powering and managing2 these systems requires large wiring harnesses. The math is pretty simple to make the case for such a change - using 48V instead of the current industry standard 12 volts DC allows the individual wires in a wiring harness to be smaller, thus less expensive (less copper), lighter weight, and simpler to assemble and install (smaller wires are more flexible, etc.) It's purely a guess on my part, but I'll guess that the power conversion from the main battery bus voltage in a Tesla vehicle (hundreds of volts / hundreds of amps) to 48 volts / lower current is more efficient than conversion to 12 volts / higher current.

The automotive industry's primary argument against using 48V3 is the inertia of the suppliers that don't want to make "non-standard" components such as a 48V motor. Tesla shrugs off this argument because it is vertically integrated, and thus purchases few generic components from suppliers. Another reason that Tesla can decide to make this change is that they are world class experts at efficient, cost-effective power conversion - stepping voltages down to 48V and 12V (if necessary) is, for them, trivial and efficient.

The use of 48V DC is widespread in other industries.

- I remember reading in Home Power Magazine that a primary argument for "whole house battery banks" to *not* use 12 volts is that the wire size required for 12V systems were expensive, hard to fabricate, and the required currents were more dangerous. 48V battery banks and inverters became the norm.
- Power over Ethernet uses 48V.
- Computers in data centers are increasingly using 48V because there is lower power loss (in every computer in a rack) converting from 48V DC to the 5V DC and 3.3V DC used in the actual circuits, compared to converting from 120V AC or 240V AC to 5V DC and 3.3V DC.

It's early days of this transition, so Amateur Radio units will continue to use 12V DC power input for the immediate future. With the advent of remote mounted radios such as the Icom IC-905, and microwave units used for AREDN that use Power over Ethernet, there is already *some* movement in Amateur Radio to embrace 48 volts DC as a new power input standard. As a result of Tesla's movement to 48V for the internal power bus of its future vehicles, I'll guess that radio manufacturers building commercial two way radios will soon begin offering units that can use 48V power input.

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ZR > BEACON

A primary limitation of an email newsletter is that it can only be so large before it runs the risk of being… "managed"… by the big email platforms such as Gmail (potentially) not allowing it to go through because it's too large.

Unfortunately, limiting the size of an email newsletter forces triage of timely, interesting information.

Starting with this issue, for at least a few issues, I will conduct an experiment for at least a few weeks. The "Quick Mentions" that would normally appear here in ZR > BEACON will be published in a separate edition of Zero Retries that (this week) will be called Zero **Retries 0091 - BEACON Edition**.

My intent is that the separate editions will allow both the "long form" articles and the "quick mentions" to both be more timely and complete.

Zero Retries 0091 Poll

Feedback Loop

Comments:

- **Jason Milldrum NT7S** re: Zero Retries 0090 - *I'm interested in finding more hams on Substack, both authors and readers. I'm curious if you have any ideas on how to help to encourage engagement on this very nice platform.*

If you provide feedback via email, I may excerpt your feedback or include it in full. Unless you specifically grant me permission to include your name, I won't do so. Feedback may be lightly edited for clarity.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out
Join the Fun on Amateur Radio for some pointers.

Zero Retries Frequently Asked Questions (FAQs) - In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- **Pseudostaffers** Dan Romanchik KB6NU and Jeff Davis KE9V for continuing to spot, and write about "Zero Retries Interesting" items on their blogs that I don't spot on my own.
- **Newsletters** that regularly feature Zero Retries Interesting content:
    - Amateur Radio Weekly by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories.
    - Experimental Radio News by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC.
- **YouTube channels** that regularly feature Zero Retries Interesting content:
    - HB9BLA Wireless by Andreas Spiess HB9BLA
    - KM6LYW Radio by Craig Lamparter KM6LY emphasizes Amateur Radio data communications such as the DigiPi project.
    - Tech Minds by Matthew Miller M0DQW is subtitled Ham Radio - SDR - RF Projects - Software - Tutorials.
- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

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Zero Retries / N8GNJ on Mastodon

Email issues of Zero Retries are "instrumented" by Substack to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted in beautiful Bellingham (The City of Subdued Excitement), Washington, USA.

2023-03-24

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1

The drive train - main battery, drive motor, etc. will continue to be high voltage / high power.

2

Another interesting technical detail was Tesla uses *Ethernet* to communicate between electronic modules.

3

Apparently a change from 12V to 48V has been debated within the industry for years.